

09/870,534

Patent  
IBM Docket No. F15920000349US1

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Assistant Commissioner for Patents, ALEXANDRIA, VA 22313-1450.

Date of Deposit: 10/02/03  
Name of Person Making Deposit: Linda Roberts-Jackson  
Signature: 

**In the United States Patent and Trademark Office**

|                              |   |                  |                          |
|------------------------------|---|------------------|--------------------------|
| <b>Date:</b>                 | 10/02/03  | <b>Filed:</b>    | 5/31/01                  |
| <b>In re Application of:</b> | Kamalesh Srivastava, et al.   |                  |                          |
| <b>For:</b>                  | A METHOD OF IMPROVING UNIFORMITY OF ETCHING OF A FILM ON AN ARTICLE |                  |                          |
| <b>Serial Number:</b>        | 09/870,534  |                  |                          |
| <b>Art Unit:</b>             | 1765  | <b>Examiner:</b> | UMEZ ERONINI,<br>LYNETTE |

**APPEAL BRIEF**

Hon. Commissioner of Patents and Trademarks  
Alexandria, VA 22313-1450

Dear Sir:

On July 2, 2003, Appellants appealed to the Board of Patent Appeals and Interferences from the decision of the Primary Examiner finally rejecting claims 1 to 12, 14 and 15. What follows is Appellants Appeal Brief as required by 37 CFR 1.192(a).

09/870,534

**Patent**  
**IBM Docket No. FIS920000349US1**

**REAL PARTY IN INTEREST:**

International Business Machines Corporation is the real party in interest in this appeal.

**RELATED APPEALS AND INTERFERENCES:**

There are no related appeals and interferences.

**STATUS OF CLAIMS:**

Claims 1 to 12, 14 and 15 are all of the claims pending in this appeal. Claim 13 was canceled without prejudice in Appellants' Amendment filed January 23, 2003. Claims 1 to 12, 14 and 15 are being appealed.

**STATUS OF AMENDMENTS:**

A response, styled as an Amendment After Final Rejection, subsequent to the Final

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Rejection of April 2, 2003, was filed June 2, 2003. In an Advisory Action mailed June 20, 2003, this response was considered but was deemed to not place the application in condition for allowance.

**SUMMARY OF INVENTION:**

In the semiconductor industry, so-called "solder bumps" are tiny quantities of solder used to connect semiconductor devices (also known as chips) and similar articles to chip packages and the like. Equivalent terms for solder bumps are C4, controlled collapse chip connection, solder balls, flip chip connection and C4 solder bump. The semiconductor devices and similar articles are usually made in rectangular arrays on a mono-crystalline slab of silicon, called a wafer. The solder bumps are placed on the semiconductor devices and similar articles while they are still joined in a wafer.

The solder bumps may be formed by the deposition of solder onto a continuous stack of metal films across the wafer to be bumped. The stack of metal films remains under the solder bump in the final structure and forms the basis for the so-called ball limiting metallurgy, sometimes also called the underbump metallurgy. The stack of metal films is removed in between the solder bumps to electrically isolate them by suitable wet and/or dry electrolytic

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

etching processes.

The challenge in the etching process is to effectively remove or etch the metal films without otherwise harming the solder bumps.

It has been found that wet etching of the stack of metal films is complicated by the presence of the solder bumps. The present inventors have further found that the stack of metal films wet etches slower at the kerf area of the semiconductor wafer where there are usually no solder bumps thereby making uniform etching of the semiconductor wafer difficult. Figure 1 of the present application illustrates a portion of a semiconductor wafer (i.e., one semiconductor device 30) having solder bumps 32, 34 and a kerf area 36. See also specification page 8, lines 1-15.

The present invention, then, is directed to a method of improving the uniformity of etching of metallic films having a plurality of solder bumps on semiconductor wafers. However, the teaching of the present invention can be applied also to the etching of nonmetallic films having a plurality of solder bumps on articles other than semiconductor wafers.

Figures 2 to 4 illustrate an apparatus for practicing the method of the present invention. The semiconductor wafer/article 20 having a metallic or nonmetallic film and a plurality of

**09/870,534****Patent****IBM Docket No. FIS920000349US1**

solder bumps is mounted on rotating chuck 18 which is then immersed in a tank 24 of etchant 26.

The semiconductor wafer 20 is rotated, continuously or sequentially as desired, for a predetermined amount of time so as to improve the uniformity of the etching of the film. The semiconductor wafer/article 20 is then removed from the tank 24 of etchant 26. (Specification page 10, lines 9-24 and page 11, line 1; claims 1 and 8).

It was found that the method of the present invention led to a marked improvement in the uniformity of the etching of the film. For example, one method of measurement of the uniformity of the etching of the film, the "wet etch uniformity", showed about a 35% improvement in the wet etch uniformity according to the present invention. (Specification page 15, lines 1-9).

A copy of the claims on appeal are set forth in the Appendix.

**ISSUES:**

- I. Whether claims 1, 4, 5 and 6 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk U.S. Patent 5,340,437 in view of Datta et al. U.S. Patent 5,462,638.

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

- II. Whether claims 2 and 3 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Takeshi et al. (English Abstract of JP 9115977 A2).
- III. Whether claim 7 has been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Barbee et al. U.S. Patent 5,445,705.
- IV. Whether claims 8, 11, 12 and 14 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Barbee ( or Datta et al.?).
- V. Whether claims 9 and 10 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Takeshi et al. (English Abstract of JP 9115977 A2).
- VI. Whether claim 15 has been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Barbee et al. U.S. Patent 5,445,705.

09/870,534

**Patent**  
**IBM Docket No. FIS920000349US1****GROUPING OF CLAIMS:**

**All claims do not stand or fall together.** Claims 1 and 8 stand together and claim 1 is representative of this group. Claims 2, 3, 9 and 10 stand together and claim 2 is representative of this group. The remaining claims will stand or fall based on the patentability of claims 1 and 8. Arguments for the separate patentability for these two groups of claims will be presented in the Argument section of this Appeal Brief.

**ARGUMENT:**

I. Claims 1, 4, 5 and 6 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk U.S. Patent 5,340,437 (hereafter "Erk") in view of Datta et al. U.S. Patent 5,462,638 (hereafter "Datta").

The present invention as embodied in claim 1 is directed to the improved uniformity of etching of a film having a plurality of solder bumps. Appellants have found and asserted that this film etches slower at the kerf area of a semiconductor wafer where there are usually no C4 solder structures. (Appellants' specification page 3, lines 21-23 and page 4, line 1). Accordingly, in order to solve this problem first discovered by Appellants, Appellants have proposed rotating the

**09/870,534****Patent****IBM Docket No. FIS920000349US1**

wafer to improve the uniformity of etching. The combination of references proposed by the Examiner do not suggest the problem found by Appellants nor its solution. "[A] patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is *part* of the 'subject matter as a whole' which should always be considered in determining the obviousness of an invention under 35 U.S.C. 103." In re Spinnable, 160 USPQ 237, 243 (CCPA 1969). The Examiner has not addressed this part of Appellants' invention in the Examiner's rejection of claim 1 and thus has failed to consider the "subject matter as a whole" of Appellants' invention.

Turning now to the references, Erk is directed to a process wherein a bare silicon wafer, which has been sawed and lapped, is immersed in an etchant bath and then rotated. The etching step is necessary to remove any work damage created by the sawing and lapping and to remove any embedded lapping grit. Among the objects of Erk are to uniformly etch the bare silicon wafer at slow rotation speeds and to have a relatively low total thickness variation across the wafer.

However, the Erk reference is distinguishable on at least three counts from Appellants' invention as embodied in claim 1. The first is that Erk is directed to the etching of bare silicon wafers to remove any residual effects of sawing and lapping. It is to be assumed that as a result of the etching process in Erk, such residual effects would be removed. There is nothing in Erk to indicate that the teachings of Erk would be applicable to any other process other than the removal



**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

of such residual effects.

Second, Appellants' claim 1 is directed to a "method of improving the uniformity of etching of a film having a plurality of solder bumps" [emphasis added]. Improving the uniformity of etching is an important limitation of Appellants' claim 1. While Erk appears to address thickness variations, both locally and across the entire wafer (col. 2, lines 22-29), this is not the same as uniformly etching a film across the entire wafer as taught by Appellants. That is, Appellants want the same etching in the kerf area and the area with the solder bumps. Since Erk is etching a bare wafer, Erk cannot address this aspect of Appellants' invention.

Third, the teaching of Appellants' invention is that the presence of the solder bumps complicates the etching of the metal films (Appellants' specification page 3, lines 20-21). It cannot be assumed that the etching of a bare wafer as taught by Erk would be applicable to the etching of a wafer with a film having a plurality of solder bumps. Thus, there is no teaching in Erk to indicate that Erk would be applicable to improving the uniformity of etching of a film having a plurality of solder bumps as claimed by Appellants.

The deficiencies of Erk are not supplied by Datta. Datta is directed to the etching of one of the metallic films (i.e., TiW) underlying the solder bumps and merely teaches, as recognized by the Examiner, that for a semiconductor wafer having solder bumps, the metallic film may be

**09/870,534****Patent****IBM Docket No. FIS920000349US1**

etched by "dip etching, which allows economical production with a simple throughput cassette-type etching process." (col. 7, lines 45-46). There is nothing in Datta to suggest the problem found by Appellants of nonuniform etching. Nor is there anything in Datta to suggest a method of etching by any other method than dip etching in a cassette-type etching process.

The Examiner states, however, that it would be obvious "...to modify Erk by immersing an article having a plurality of solder bumps as taught by Datta in a tank of etchant for the purpose of allowing economical production with simple throughput cassette-type etching process". It is not understood how the Examiner can jump from the Datta dip etching process where the wafers are in a cassette to a process, as claimed by Appellants, where the wafer is rotated to improve the uniformity of etching. Moreover, the Examiner seems to modify Erk by the cassette-type dip etching of Datta. Cassette-type dip etching is not what Appellants are claiming!

The Examiner concludes in the Final Office Action that "Since Erk in view of Datta use the same steps and film layer as those of the claimed invention, then combining Erk and Datta would inherently result in a method of improving the uniformity of etching of a film on an article as in the present invention." [emphasis added]. It is submitted that the Examiner's reasoning is flawed in that the foregoing reasoning is applicable to an anticipation rejection based on a single reference but is not applicable to an obviousness rejection based on multiple references. In re

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

Rinehart, 189 USPQ 143 (CCPA 1976), In re Spormann, 150 USPQ 449 (CCPA 1966). It is noted that in the Advisory Action the Examiner has deleted the word "inherently". However, removal of "inherently" does not remove the Examiner's burden to provide a valid motivation for combining Erk and Datta.

Any motivation provided by the Examiner above for the combining of Erk and Datta is negated by the fact that Erk and Datta use different processes and wafers in their respective etching processes. "The fact that a prior art reference can be modified to show the patented invention does not make the modification obvious unless the prior art reference suggests the desirability of the modification. An attempted modification of a prior art reference that is unwarranted by the disclosure of that reference is improper." In re Gordon, 221 U.S.P.Q. 1125, 1127 (CAFC 1984).

If modified as suggested by the Examiner above, there would be a different process than that claimed by Appellants since Erk and Datta do not use the same steps and film layer. That is, Erk has no film layer and no solder bumps and immerses and rotates the wafer in an etching bath. Datta, conversely, does have a metallic film layer but etches the wafer in a cassette-type dip etching process. It should be readily apparent that Erk and Datta are directed to two different types of processes with two different kinds of wafers.

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

Given the flawed reasoning by the Examiner, it is submitted that the Examiner has yet to state a cogent motivation for combining Erk and Datta so as to render obvious Appellants' claim

1.

The Office has the burden under 35 USC §103 to establish a prima facie case of obviousness. In re Fine, 5 USPQ2d 1596 (CAFC 1997). "In determining whether a case of prima facie obviousness exists, it is necessary to ascertain whether the prior art teachings would appear to be sufficient to one of ordinary skill in the art to suggest making the claimed substitution or other modifications. [citations omitted] The prior art must provide one of ordinary skill in the art the motivation to make the proposed molecular modifications needed to arrive at the claimed compound." In re Lalu and Foulletier, 223 USPQ 1257, 1258 (CAFC 1984). "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." In re Fritch, 23 USPQ 2d 1780, 1783 (CAFC 1992).

In view of the preceding remarks, it is submitted that the Examiner has failed to state a prima facie case of obviousness with respect to claim 1. Accordingly, claim 1 should be allowable.

Inasmuch as claims 4 to 6 depend from claim 1, and claim 1 is believed to be allowable,

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

then claims 4 to 6 should be allowable as well. No independent ground of patentability is asserted for claims 4 to 6.

II. Claims 2 and 3 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta and further in view of Takeshi et al. (English Abstract of JP 9115977 A2) (hereafter "Takeshi"). Claim 7 has been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta and further in view of Barbee et al. U.S. Patent 5,445,705 (hereafter "Barbee").

Inasmuch as claims 2, 3 and 7 depend from claim 1, and claim 1 is believed to be allowable, then claims 2, 3 and 7 should be allowable as well. No independent ground of patentability is asserted for claim 7.

Claims 2 and 3 are believed to be independently patentable.

The Examiner states that Erk in view of Datta fail to teach the step of sequentially rotating the article as claimed in claims 2 and 3. The Examiner further applies Takeshi which reads on rotating the article a predetermined amount but less than a complete rotation and repeating the step of rotating and etching. The Examiner concludes that it would have been

**09/870,534****Patent****IBM Docket No. FIS920000349US1**

obvious to modify Erk and Datta according to Takeshi "for the purpose of improving the method of detecting defects in semiconductor processing."

Erk and Datta have been discussed above. Takeshi discloses an analytical technique for detecting and analyzing so-called flow pattern defects (FPD) in semiconductor wafers. Takeshi is not directed at all to the problem faced by Appellants, to wit, improving the uniformity of a film having a plurality of solder bumps. The last statement above by the Examiner is telling. The Examiner has combined Erk, Datta and Takeshi "for the purpose of improving the method of detecting defects in semiconductor processing." That is, the Examiner has combined Erk, Datta and Takeshi to teach a solution to a problem not faced by Appellants. It is submitted that Takeshi is nonanalogous art. "In order to rely on a reference as a basis for rejection of the applicant's invention, the reference must either be in the field of the applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the inventor was concerned." In re Oetiker, 24 USPQ2d 1443, 1445 (Fed. Cir. 1992). "[T]he purposes of both the invention and the prior art are important in determining whether the reference is reasonably pertinent to the problem the invention attempts to solve. If a reference disclosure has the same purpose as the claimed invention, the reference relates to the same problem, and that fact supports use of that reference in an obviousness rejection. An inventor may well have been motivated to consider the reference when making his invention. If it is directed to a different purpose, the inventor would accordingly have had less motivation or occasion to consider it." In re Clay, 23 USPQ2d1058,

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

1061 (Fed. Cir. 1992). In the present case, the reference is directed to a different purpose, as admitted by the Examiner, and so should be considered to be nonanalogous art. Takeshi, then, should be withdrawn as a reference.

Accordingly, with respect to claims 2 and 3, the Examiner has failed to state a prima facie case of obviousness.

**III.** Claims 8, 11, 12 and 14 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Barbee (?).

While the Examiner has recited Barbee as the secondary reference, it is clear that the Examiner meant to recite Datta as the secondary reference in view of the Examiner's rationale for the rejection of claims 8, 11, 12 and 14.

Therefore, the reasoning recited by Appellants for the allowability of claim 1 is equally applicable here for the allowability of claim 8. That reasoning recited earlier is incorporated by reference herein. Accordingly, claim 8 should be allowable.

Inasmuch as claims 11, 12 and 14 depend from claim 8, and claim 8 is believed to be

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

allowable, then claims 11, 12 and 14 should be allowable as well. No independent ground of patentability is asserted for claims 11, 12 and 14.

IV. Claims 9 and 10 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Takeshi et al. (English Abstract of JP 9115977 A2). Claim 15 has been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Barbee et al. U.S. Patent 5,445,705.

Inasmuch as claims 9, 10 and 15 depend from claim 8, and claim 8 is believed to be allowable, then claims 9, 10 and 15 should be allowable as well. No independent ground of patentability is asserted for claim 15.

Claims 9 and 10 are submitted to be independently patentable for substantially the same reasons advanced in favor of claims 2 and 3 and those reasons are incorporated by reference herein.

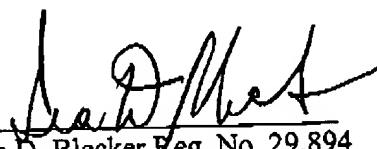


**09/870,534****Patent  
IBM Docket No. FIS920000349US1****SUMMARY:**

For all the reasons presented, it is submitted that the Examiner's various decisions in rejecting Appellants' claims were in error and reversal of the Examiner's decisions is respectfully requested.

Respectfully Submitted,  
Kamalesh Srivastava, et al.

OFFICIAL

  
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**09/870,534****Patent  
IBM Docket No. FIS920000349US1****APPENDIX**

1. A method of improving the uniformity of etching of a film having a plurality of solder bumps on an article, the method comprising the steps of:

immersing the article containing the film having a plurality of solder bumps into a tank of etchant;

rotating the article while in the etchant for an amount of time so as to cause improved uniformity of etching of the film across the entire article compared to etching without rotating the article; and

removing the article from the tank of etchant.

2. The method of claim 1 wherein the step of rotating comprises sequentially rotating the article.

3. The method of claim 1 wherein the step of sequentially rotating comprises rotating the article

**Patent****IBM Docket No. FIS920000349US1****09/870,534**

an amount but less than a complete rotation, etching the article an amount of time, and repeating the steps of rotating and etching for an amount of time.

4. The method of claim 1 wherein the step of rotating comprises continuously rotating the article an amount of time.

5. The method of claim 1 wherein in the step of rotating, the article is rotated at a speed of 1 to 5 revolutions per minute.

6. The method of claim 1 wherein the film is a metallic film.

7. The method of claim 1 wherein the film is a nonmetallic film.

8. A method of improving the uniformity of etching of a film having a plurality of solder bumps on a semiconductor wafer, the method comprising the steps of:

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

immersing the semiconductor wafer containing the film having a plurality of solder bumps into a tank of etchant;

rotating the semiconductor wafer while in the etchant for an amount of time; and

removing the semiconductor wafer from the tank of etchant.

9. The method of claim 8 wherein the step of rotating comprises sequentially rotating the semiconductor wafer.

10. The method of claim 8 wherein the step of sequentially rotating comprises rotating the semiconductor wafer an amount but less than a complete rotation, etching the semiconductor wafer an amount of time, and repeating the steps of rotating and etching for an amount of time.

11. The method of claim 8 wherein the step of rotating comprises continuously rotating the semiconductor wafer an amount of time.

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

12. The method of claim 8 wherein in the step of rotating, the semiconductor wafer is rotated at a speed of 1 to 5 revolutions per minute.

14. The method of claim 8 wherein the film is a metallic film.

15. The method of claim 8 wherein the film is a nonmetallic film.

**COMBINED TRANSMITTAL OF APPEAL BRIEF TO THE BOARD OF PATENT  
APPEALS AND INTERFERENCES & PETITION FOR EXTENSION OF TIME  
UNDER 37 C.F.R. 1.136(a) (Large Entity)**Docket No.  
**FIS920000349US1**In Re Application Of: **Kamalesh Srivastava , et al.**Serial No.  
**09/870,534**Filing Date  
**5/31/01**Examiner  
**UMEZ ERONINI, L.**Group Art Unit  
**1765**

Invention:

**A METHOD OF IMPROVING UNIFORMITY OF ETCHING OF A FILM ON AN ARTICLE****TO THE COMMISSIONER FOR PATENTS:**

This is a combined Transmittal of Appeal Brief to the Board of Patent Appeals and Interferences and petition under the provisions of 37 CFR 1.136(a) to extend the period for filing an Appeal Brief.

Applicant(s) hereby request(s) an extension of time of (check desired time period):

☒ One month      ☐ Two months      ☐ Three months      ☐ Four months      ☐ Five months

from: 9/02/03      until: 10/02/03  
Date      Date

The fee for the Appeal Brief and Extension of Time has been calculated as shown below:

Fee for Appeal Brief: \$330.00Fee for Extension of Time: \$110.00**TOTAL FEE FOR APPEAL BRIEF AND EXTENSION OF TIME:** \$440.00

The fee for the Appeal Brief and extension of time is to be paid as follows:

☐ A check in the amount of \_\_\_\_\_ for the Appeal Brief and extension of time is enclosed.

☒ Please charge Deposit Account No. **090458-FI339** in the amount of **\$440.00**

☒ The Director is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. **090458**

☒ Any additional filing fees required under 37 C.F.R. 1.16.

☒ Any patent application processing fees under 37 CFR 1.17.

☒ If an additional extension of time is required, please consider this a petition therefor and charge any additional fees which may be required to Deposit Account No. **090458**

P34LARGE/REV01

**COMBINED TRANSMITTAL OF APPEAL BRIEF TO THE BOARD OF PATENT  
APPEALS AND INTERFERENCES & PETITION FOR EXTENSION OF TIME  
UNDER 37 C.F.R. 1.136(a) (Large Entity)**Docket No.  
**FIS920000349US1**In Re Application Of: **Kamalesh Srivastava , et al.**Serial No.  
**09/870,534**Filing Date  
**5/31/01**Examiner  
**UMEZ ERONINI, L.**Group Art Unit  
**1765**

Invention:

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This combined Transmittal of Appeal Brief to the Board of Patent Appeals and Interferences and petition for extension of time under 37 CFR 1.136(a) is respectfully submitted by the undersigned:

  
SignatureDated: **10/02/03****IRA D. BLECKER, REG. NO. 29,894  
2070 ROUTE 52  
HOPEWELL JUNCTION, NY 12533****Certificate of Transmission by Facsimile\***

I certify that this document and authorization to charge deposit account is being facsimile transmitted to the United States Patent and Trademark Office  
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**Patent**  
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Assistant Commissioner for Patents, ALEXANDRIA, VA 22313-1450.

Date of Deposit: 10/02/03

Name of Person Making Deposit: Linda Roberts-Jackson

Signature

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**In the United States Patent and Trademark Office**

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**Date:** 10/02/03**In re Application of:** Kamalesh Srivastava, et al.**Filed:** 5/31/01**For:** A METHOD OF IMPROVING UNIFORMITY OF ETCHING OF A  
FILM ON AN ARTICLE**Serial Number:** 09/870,534**Art Unit:** 1765**Examiner:** UMEZ ERONINI,  
LYNETTE**APPEAL BRIEF**

Hon. Commissioner of Patents and Trademarks  
Alexandria, VA 22313-1450

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International Business Machines Corporation is the real party in interest in this appeal.

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**SUMMARY OF INVENTION:**

In the semiconductor industry, so-called "solder bumps" are tiny quantities of solder used to connect semiconductor devices (also known as chips) and similar articles to chip packages and the like. Equivalent terms for solder bumps are C4, controlled collapse chip connection, solder balls, flip chip connection and C4 solder bump. The semiconductor devices and similar articles are usually made in rectangular arrays on a mono-crystalline slab of silicon, called a wafer. The solder bumps are placed on the semiconductor devices and similar articles while they are still joined in a wafer.

The solder bumps may be formed by the deposition of solder onto a continuous stack of metal films across the wafer to be bumped. The stack of metal films remains under the solder bump in the final structure and forms the basis for the so-called ball limiting metallurgy, sometimes also called the underbump metallurgy. The stack of metal films is removed in between the solder bumps to electrically isolate them by suitable wet and/or dry electrolytic

**09/870,534****Patent  
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etching processes.

The challenge in the etching process is to effectively remove or etch the metal films without otherwise harming the solder bumps.

It has been found that wet etching of the stack of metal films is complicated by the presence of the solder bumps. The present inventors have further found that the stack of metal films wet etches slower at the kerf area of the semiconductor wafer where there are usually no solder bumps thereby making uniform etching of the semiconductor wafer difficult. Figure 1 of the present application illustrates a portion of a semiconductor wafer (i.e., one semiconductor device 30) having solder bumps 32, 34 and a kerf area 36. See also specification page 8, lines 1-15.

The present invention, then, is directed to a method of improving the uniformity of etching of metallic films having a plurality of solder bumps on semiconductor wafers. However, the teaching of the present invention can be applied also to the etching of nonmetallic films having a plurality of solder bumps on articles other than semiconductor wafers.

Figures 2 to 4 illustrate an apparatus for practicing the method of the present invention. The semiconductor wafer/article 20 having a metallic or nonmetallic film and a plurality of

**Patent****IBM Docket No. FIS920000349US1****09/870,534**

solder bumps is mounted on rotating chuck 18 which is then immersed in a tank 24 of etchant 26.

The semiconductor wafer 20 is rotated, continuously or sequentially as desired, for a predetermined amount of time so as to improve the uniformity of the etching of the film. The semiconductor wafer/article 20 is then removed from the tank 24 of etchant 26. (Specification page 10, lines 9-24 and page 11, line 1; claims 1 and 8).

It was found that the method of the present invention led to a marked improvement in the uniformity of the etching of the film. For example, one method of measurement of the uniformity of the etching of the film, the "wet etch uniformity", showed about a 35% improvement in the wet etch uniformity according to the present invention. (Specification page 15, lines 1-9).

A copy of the claims on appeal are set forth in the Appendix.

**ISSUES:**

- I. Whether claims 1, 4, 5 and 6 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk U.S. Patent 5,340,437 in view of Datta et al. U.S. Patent 5,462,638.

**09/870,534****Patent**  
**IBM Docket No. FIS920000349US1**

- II. Whether claims 2 and 3 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Takeshi et al. (English Abstract of JP 9115977 A2).
- III. Whether claim 7 has been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Barbee et al. U.S. Patent 5,445,705.
- IV. Whether claims 8, 11, 12 and 14 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Barbee ( or Datta et al.?).
- V. Whether claims 9 and 10 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Takeshi et al. (English Abstract of JP 9115977 A2).
- VI. Whether claim 15 has been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Barbee et al. U.S. Patent 5,445,705.

09/870,534

**Patent**  
**IBM Docket No. FIS920000349US1**

**GROUPING OF CLAIMS:**

**All claims do not stand or fall together.** Claims 1 and 8 stand together and claim 1 is representative of this group. Claims 2, 3, 9 and 10 stand together and claim 2 is representative of this group. The remaining claims will stand or fall based on the patentability of claims 1 and 8. Arguments for the separate patentability for these two groups of claims will be presented in the Argument section of this Appeal Brief.

**ARGUMENT:**

I. Claims 1, 4, 5 and 6 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk U.S. Patent 5,340,437 (hereafter "Erk") in view of Datta et al. U.S. Patent 5,462,638 (hereafter "Datta").

The present invention as embodied in claim 1 is directed to the improved uniformity of etching of a film having a plurality of solder bumps. Appellants have found and asserted that this film etches slower at the kerf area of a semiconductor wafer where there are usually no C4 solder structures. (Appellants' specification page 3, lines 21-23 and page 4, line 1). Accordingly, in order to solve this problem first discovered by Appellants, Appellants have proposed rotating the

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

wafer to improve the uniformity of etching. The combination of references proposed by the Examiner do not suggest the problem found by Appellants nor its solution. "[A] patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is *part* of the 'subject matter as a whole' which should always be considered in determining the obviousness of an invention under 35 U.S.C. 103." In re Spinnable, 160 USPQ 237, 243 (CCPA 1969). The Examiner has not addressed this part of Appellants' invention in the Examiner's rejection of claim 1 and thus has failed to consider the "subject matter as a whole" of Appellants' invention.

Turning now to the references, Erk is directed to a process wherein a bare silicon wafer, which has been sawed and lapped, is immersed in an etchant bath and then rotated. The etching step is necessary to remove any work damage created by the sawing and lapping and to remove any embedded lapping grit. Among the objects of Erk are to uniformly etch the bare silicon wafer at slow rotation speeds and to have a relatively low total thickness variation across the wafer.

However, the Erk reference is distinguishable on at least three counts from Appellants' invention as embodied in claim 1. The first is that Erk is directed to the etching of bare silicon wafers to remove any residual effects of sawing and lapping. It is to be assumed that as a result of the etching process in Erk, such residual effects would be removed. There is nothing in Erk to indicate that the teachings of Erk would be applicable to any other process other than the removal

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

of such residual effects.

Second, Appellants' claim 1 is directed to a "method of improving the uniformity of etching of a film having a plurality of solder bumps" [emphasis added]. Improving the uniformity of etching is an important limitation of Appellants' claim 1. While Erk appears to address thickness variations, both locally and across the entire wafer (col. 2, lines 22-29), this is not the same as uniformly etching a film across the entire wafer as taught by Appellants. That is, Appellants want the same etching in the kerf area and the area with the solder bumps. Since Erk is etching a bare wafer, Erk cannot address this aspect of Appellants' invention.

Third, the teaching of Appellants' invention is that the presence of the solder bumps complicates the etching of the metal films (Appellants' specification page 3, lines 20-21). It cannot be assumed that the etching of a bare wafer as taught by Erk would be applicable to the etching of a wafer with a film having a plurality of solder bumps. Thus, there is no teaching in Erk to indicate that Erk would be applicable to improving the uniformity of etching of a film having a plurality of solder bumps as claimed by Appellants.

The deficiencies of Erk are not supplied by Datta. Datta is directed to the etching of one of the metallic films (i.e., TiW) underlying the solder bumps and merely teaches, as recognized by the Examiner, that for a semiconductor wafer having solder bumps, the metallic film may be



**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

etched by "dip etching, which allows economical production with a simple throughput cassette-type etching process." (col. 7, lines 45-46). There is nothing in Datta to suggest the problem found by Appellants of nonuniform etching. Nor is there anything in Datta to suggest a method of etching by any other method than dip etching in a cassette-type etching process.

The Examiner states, however, that it would be obvious "...to modify Erk by immersing an article having a plurality of solder bumps as taught by Datta in a tank of etchant for the purpose of allowing economical production with simple throughput cassette-type etching process". It is not understood how the Examiner can jump from the Datta dip etching process where the wafers are in a cassette to a process, as claimed by Appellants, where the wafer is rotated to improve the uniformity of etching. Moreover, the Examiner seems to modify Erk by the cassette-type dip etching of Datta. Cassette-type dip etching is not what Appellants are claiming!

The Examiner concludes in the Final Office Action that "Since Erk in view of Datta use the same steps and film layer as those of the claimed invention, then combining Erk and Datta would inherently result in a method of improving the uniformity of etching of a film on an article as in the present invention." [emphasis added]. It is submitted that the Examiner's reasoning is flawed in that the foregoing reasoning is applicable to an anticipation rejection based on a single reference but is not applicable to an obviousness rejection based on multiple references. In re

**09/870,534****Patent****IBM Docket No. FIS920000349US1**

Rinehart, 189 USPQ 143 (CCPA 1976), In re Spormann, 150 USPQ 449 (CCPA 1966). It is noted that in the Advisory Action the Examiner has deleted the word "inherently". However, removal of "inherently" does not remove the Examiner's burden to provide a valid motivation for combining Erk and Datta.

Any motivation provided by the Examiner above for the combining of Erk and Datta is negated by the fact that Erk and Datta use different processes and wafers in their respective etching processes. "The fact that a prior art reference can be modified to show the patented invention does not make the modification obvious unless the prior art reference suggests the desirability of the modification. An attempted modification of a prior art reference that is unwarranted by the disclosure of that reference is improper." In re Gordon, 221 U.S.P.Q. 1125, 1127 (CAFC 1984).

If modified as suggested by the Examiner above, there would be a different process than that claimed by Appellants since Erk and Datta do not use the same steps and film layer. That is, Erk has no film layer and no solder bumps and immerses and rotates the wafer in an etching bath. Datta, conversely, does have a metallic film layer but etches the wafer in a cassette-type dip etching process. It should be readily apparent that Erk and Datta are directed to two different types of processes with two different kinds of wafers.

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

Given the flawed reasoning by the Examiner, it is submitted that the Examiner has yet to state a cogent motivation for combining Erk and Datta so as to render obvious Appellants' claim

1.

The Office has the burden under 35 USC §103 to establish a prima facie case of obviousness. In re Fine, 5 USPQ2d 1596 (CAFC 1597). "In determining whether a case of prima facie obviousness exists, it is necessary to ascertain whether the prior art teachings would appear to be sufficient to one of ordinary skill in the art to suggest making the claimed substitution or other modifications. [citations omitted] The prior art must provide one of ordinary skill in the art the motivation to make the proposed molecular modifications needed to arrive at the claimed compound." In re Lalu and Foulletier, 223 USPQ 1257, 1258 (CAFC 1984). "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." In re Fritch, 23 USPQ 2d 1780, 1783 (CAFC 1992).

In view of the preceding remarks, it is submitted that the Examiner has failed to state a prima facie case of obviousness with respect to claim 1. Accordingly, claim 1 should be allowable.

Inasmuch as claims 4 to 6 depend from claim 1, and claim 1 is believed to be allowable,

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

then claims 4 to 6 should be allowable as well. No independent ground of patentability is asserted for claims 4 to 6.

II. Claims 2 and 3 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta and further in view of Takeshi et al. (English Abstract of JP 9115977 A2) (hereafter "Takeshi"). Claim 7 has been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta and further in view of Barbee et al. U.S. Patent 5,445,705 (hereafter "Barbee").

Inasmuch as claims 2, 3 and 7 depend from claim 1, and claim 1 is believed to be allowable, then claims 2, 3 and 7 should be allowable as well. No independent ground of patentability is asserted for claim 7.

Claims 2 and 3 are believed to be independently patentable.

The Examiner states that Erk in view of Datta fail to teach the step of sequentially rotating the article as claimed in claims 2 and 3. The Examiner further applies Takeshi which reads on rotating the article a predetermined amount but less than a complete rotation and repeating the step of rotating and etching. The Examiner concludes that it would have been

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

obvious to modify Erk and Datta according to Takeshi "for the purpose of improving the method of detecting defects in semiconductor processing."

Erk and Datta have been discussed above. Takeshi discloses an analytical technique for detecting and analyzing so-called flow pattern defects (FPD) in semiconductor wafers. Takeshi is not directed at all to the problem faced by Appellants, to wit, improving the uniformity of a film having a plurality of solder bumps. The last statement above by the Examiner is telling. The Examiner has combined Erk, Datta and Takeshi "for the purpose of improving the method of detecting defects in semiconductor processing." That is, the Examiner has combined Erk, Datta and Takeshi to teach a solution to a problem not faced by Appellants. It is submitted that Takeshi is nonanalogous art. "In order to rely on a reference as a basis for rejection of the applicant's invention, the reference must either be in the field of the applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the inventor was concerned." In re Oetiker, 24 USPQ2d 1443, 1445 (Fed. Cir. 1992). "[T]he purposes of both the invention and the prior art are important in determining whether the reference is reasonably pertinent to the problem the invention attempts to solve. If a reference disclosure has the same purpose as the claimed invention, the reference relates to the same problem, and that fact supports use of that reference in an obviousness rejection. An inventor may well have been motivated to consider the reference when making his invention. If it is directed to a different purpose, the inventor would accordingly have had less motivation or occasion to consider it." In re Clay, 23 USPQ2d 1058,

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

1061 (Fed. Cir. 1992). In the present case, the reference is directed to a different purpose, as admitted by the Examiner, and so should be considered to be nonanalogous art. Takeshi, then, should be withdrawn as a reference.

Accordingly, with respect to claims 2 and 3, the Examiner has failed to state a prima facie case of obviousness.

III. Claims 8, 11, 12 and 14 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Barbee (?).

While the Examiner has recited Barbee as the secondary reference, it is clear that the Examiner meant to recite Datta as the secondary reference in view of the Examiner's rationale for the rejection of claims 8, 11, 12 and 14.

Therefore, the reasoning recited by Appellants for the allowability of claim 1 is equally applicable here for the allowability of claim 8. That reasoning recited earlier is incorporated by reference herein. Accordingly, claim 8 should be allowable.

Inasmuch as claims 11, 12 and 14 depend from claim 8, and claim 8 is believed to be

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

allowable, then claims 11, 12 and 14 should be allowable as well. No independent ground of patentability is asserted for claims 11, 12 and 14.

IV. Claims 9 and 10 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Takeshi et al. (English Abstract of JP 9115977 A2). Claim 15 has been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Barbee et al. U.S. Patent 5,445,705.

Inasmuch as claims 9, 10 and 15 depend from claim 8, and claim 8 is believed to be allowable, then claims 9, 10 and 15 should be allowable as well. No independent ground of patentability is asserted for claim 15.

Claims 9 and 10 are submitted to be independently patentable for substantially the same reasons advanced in favor of claims 2 and 3 and those reasons are incorporated by reference herein.

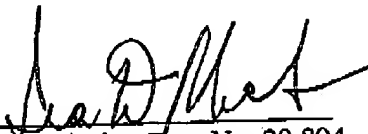
**09/870,534**

**Patent  
IBM Docket No. FIS920000349US1**

**SUMMARY:**

For all the reasons presented, it is submitted that the Examiner's various decisions in rejecting Appellants' claims were in error and reversal of the Examiner's decisions is respectfully requested.

Respectfully Submitted,  
Kamalesh Srivastava, et al.

  
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**09/870,534****Patent  
IBM Docket No. FIS920000349US1****APPENDIX**

1. A method of improving the uniformity of etching of a film having a plurality of solder bumps on an article, the method comprising the steps of:

immersing the article containing the film having a plurality of solder bumps into a tank of etchant;

rotating the article while in the etchant for an amount of time so as to cause improved uniformity of etching of the film across the entire article compared to etching without rotating the article;  
and

removing the article from the tank of etchant.

2. The method of claim 1 wherein the step of rotating comprises sequentially rotating the article.

3. The method of claim 1 wherein the step of sequentially rotating comprises rotating the article

**09/870,534****Patent****IBM Docket No. FIS920000349US1**

an amount but less than a complete rotation, etching the article an amount of time, and repeating the steps of rotating and etching for an amount of time.

4. The method of claim 1 wherein the step of rotating comprises continuously rotating the article an amount of time.

5. The method of claim 1 wherein in the step of rotating, the article is rotated at a speed of 1 to 5 revolutions per minute.

6. The method of claim 1 wherein the film is a metallic film.

7. The method of claim 1 wherein the film is a nonmetallic film.

8. A method of improving the uniformity of etching of a film having a plurality of solder bumps on a semiconductor wafer, the method comprising the steps of:

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

immersing the semiconductor wafer containing the film having a plurality of solder bumps into a tank of etchant;

rotating the semiconductor wafer while in the etchant for an amount of time; and

removing the semiconductor wafer from the tank of etchant.

9. The method of claim 8 wherein the step of rotating comprises sequentially rotating the semiconductor wafer.

10. The method of claim 8 wherein the step of sequentially rotating comprises rotating the semiconductor wafer an amount but less than a complete rotation, etching the semiconductor wafer an amount of time, and repeating the steps of rotating and etching for an amount of time.

11. The method of claim 8 wherein the step of rotating comprises continuously rotating the semiconductor wafer an amount of time.

**09/870,534**

**Patent**

**IBM Docket No. FIS920000349US1**

12. The method of claim 8 wherein in the step of rotating, the semiconductor wafer is rotated at a speed of 1 to 5 revolutions per minute.

14. The method of claim 8 wherein the film is a metallic film.

15. The method of claim 8 wherein the film is a nonmetallic film.

**COMBINED TRANSMITTAL OF APPEAL BRIEF TO THE BOARD OF PATENT  
APPEALS AND INTERFERENCES & PETITION FOR EXTENSION OF TIME  
UNDER 37 C.F.R. 1.136(a) (Large Entity)**Docket No.  
**FIS920000349US1**In Re Application Of: **Kamalesh Srivastava , et al.**Serial No.  
**09/870,534**Filing Date  
**5/31/01**Examiner  
**UMEZ ERONINI, L.**Group Art Unit  
**1765**

Invention:

**A METHOD OF IMPROVING UNIFORMITY OF ETCHING OF A FILM ON AN ARTICLE****TO THE COMMISSIONER FOR PATENTS:**

This is a combined Transmittal of Appeal Brief to the Board of Patent Appeals and Interferences and petition under the provisions of 37 CFR 1.136(a) to extend the period for filing an Appeal Brief.

Applicant(s) hereby request(s) an extension of time of (check desired time period):

☒ One month      ☐ Two months      ☐ Three months      ☐ Four months      ☐ Five months

from: 9/02/03 until: 10/02/03  
Date Date

The fee for the Appeal Brief and Extension of Time has been calculated as shown below:

Fee for Appeal Brief: \$330.00  
Fee for Extension of Time: \$110.00

**TOTAL FEE FOR APPEAL BRIEF AND EXTENSION OF TIME:** \$440.00

The fee for the Appeal Brief and extension of time is to be paid as follows:

- ☐ A check in the amount of \_\_\_\_\_ for the Appeal Brief and extension of time is enclosed.
- ☒ Please charge Deposit Account No. **090458-FI339** in the amount of **\$440.00**
- ☒ The Director is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. **090458**
- ☒ Any additional filing fees required under 37 C.F.R. 1.16.
- ☒ Any patent application processing fees under 37 CFR 1.17.
- ☒ If an additional extension of time is required, please consider this a petition therefor and charge any additional fees which may be required to Deposit Account No. **090458**

**COMBINED TRANSMITTAL OF APPEAL BRIEF TO THE BOARD OF PATENT  
APPEALS AND INTERFERENCES & PETITION FOR EXTENSION OF TIME  
UNDER 37 C.F.R. 1.136(a) (Large Entity)**Docket No.  
**FIS920000349US1**In Re Application Of: **Kamalesh Srivastava , et al.**Serial No.  
**09/870,534**Filing Date  
**5/31/01**Examiner  
**UMEZ ERONINI, L.**Group Art Unit  
**1765**

Invention:

**A METHOD OF IMPROVING UNIFORMITY OF ETCHING OF A FILM ON AN ARTICLE****TO THE COMMISSIONER FOR PATENTS:**

This combined Transmittal of Appeal Brief to the Board of Patent Appeals and Interferences and petition for extension of time under 37 CFR 1.136(a) is respectfully submitted by the undersigned:

  
SignatureDated: 10/02/03**IRA D. BLECKER, REG. NO. 29,894  
2070 ROUTE 52  
HOPEWELL JUNCTION, NY 12533****Certificate of Transmission by Facsimile\***

I certify that this document and authorization to charge deposit account is being facsimile transmitted to the United States Patent and Trademark Office  
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09/870,534

**Patent**  
**IBM Docket No. FIS920000349US1**

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Date of Deposit: 10/02/03

Name of Person Making Deposit: Linda Roberts-Jackson

Signature

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**In the United States Patent and Trademark Office**

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**Date:** 10/02/03**In re Application of:** Kamalesh Srivastava, et al.**Filed:** 5/31/01**For:** A METHOD OF IMPROVING UNIFORMITY OF ETCHING OF A  
FILM ON AN ARTICLE**Serial Number:** 09/870,534**Art Unit:** 1765**Examiner:** UMEZ ERONINI,  
LYNETTE**APPEAL BRIEF**

Hon. Commissioner of Patents and Trademarks  
Alexandria, VA 22313-1450

Dear Sir:

On July 2, 2003, Appellants appealed to the Board of Patent Appeals and Interferences from the decision of the Primary Examiner finally rejecting claims 1 to 12, 14 and 15. What follows is Appellants Appeal Brief as required by 37 CFR 1.192(a).

**09/870,534****Patent  
IBM Docket No. FIS920000349US1****REAL PARTY IN INTEREST:**

International Business Machines Corporation is the real party in interest in this appeal.

**RELATED APPEALS AND INTERFERENCES:**

There are no related appeals and interferences.

**STATUS OF CLAIMS:**

Claims 1 to 12, 14 and 15 are all of the claims pending in this appeal. Claim 13 was canceled without prejudice in Appellants' Amendment filed January 23, 2003. Claims 1 to 12, 14 and 15 are being appealed.

**STATUS OF AMENDMENTS:**

A response, styled as an Amendment After Final Rejection, subsequent to the Final



**09/870,534****Patent****IBM Docket No. FIS920000349US1**

Rejection of April 2, 2003, was filed June 2, 2003. In an Advisory Action mailed June 20, 2003, this response was considered but was deemed to not place the application in condition for allowance.

**SUMMARY OF INVENTION:**

In the semiconductor industry, so-called "solder bumps" are tiny quantities of solder used to connect semiconductor devices (also known as chips) and similar articles to chip packages and the like. Equivalent terms for solder bumps are C4, controlled collapse chip connection, solder balls, flip chip connection and C4 solder bump. The semiconductor devices and similar articles are usually made in rectangular arrays on a mono-crystalline slab of silicon, called a wafer. The solder bumps are placed on the semiconductor devices and similar articles while they are still joined in a wafer.

The solder bumps may be formed by the deposition of solder onto a continuous stack of metal films across the wafer to be bumped. The stack of metal films remains under the solder bump in the final structure and forms the basis for the so-called ball limiting metallurgy, sometimes also called the underbump metallurgy. The stack of metal films is removed in between the solder bumps to electrically isolate them by suitable wet and/or dry electrolytic

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

etching processes.

The challenge in the etching process is to effectively remove or etch the metal films without otherwise harming the solder bumps.

It has been found that wet etching of the stack of metal films is complicated by the presence of the solder bumps. The present inventors have further found that the stack of metal films wet etches slower at the kerf area of the semiconductor wafer where there are usually no solder bumps thereby making uniform etching of the semiconductor wafer difficult. Figure 1 of the present application illustrates a portion of a semiconductor wafer (i.e., one semiconductor device 30) having solder bumps 32, 34 and a kerf area 36. See also specification page 8, lines 1-15.

The present invention, then, is directed to a method of improving the uniformity of etching of metallic films having a plurality of solder bumps on semiconductor wafers. However, the teaching of the present invention can be applied also to the etching of nonmetallic films having a plurality of solder bumps on articles other than semiconductor wafers.

Figures 2 to 4 illustrate an apparatus for practicing the method of the present invention. The semiconductor wafer/article 20 having a metallic or nonmetallic film and a plurality of

**09/870,534****Patent****IBM Docket No. FIS920000349US1**

solder bumps is mounted on rotating chuck 18 which is then immersed in a tank 24 of etchant 26. The semiconductor wafer 20 is rotated, continuously or sequentially as desired, for a predetermined amount of time so as to improve the uniformity of the etching of the film. The semiconductor wafer/article 20 is then removed from the tank 24 of etchant 26. (Specification page 10, lines 9-24 and page 11, line 1; claims 1 and 8).

It was found that the method of the present invention led to a marked improvement in the uniformity of the etching of the film. For example, one method of measurement of the uniformity of the etching of the film, the "wet etch uniformity", showed about a 35% improvement in the wet etch uniformity according to the present invention. (Specification page 15, lines 1-9).

A copy of the claims on appeal are set forth in the Appendix.

**ISSUES:**

- I. Whether claims 1, 4, 5 and 6 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk U.S. Patent 5,340,437 in view of Datta et al. U.S. Patent 5,462,638.

**09/870,534****Patent****IBM Docket No. FIS920000349US1**

- II. Whether claims 2 and 3 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Takeshi et al. (English Abstract of JP 9115977 A2).
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- V. Whether claims 9 and 10 have been properly rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Takeshi et al. (English Abstract of JP 9115977 A2).
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09/870,534

**Patent**  
**IBM Docket No. FIS920000349US1****GROUPING OF CLAIMS:**

All claims do not stand or fall together. Claims 1 and 8 stand together and claim 1 is representative of this group. Claims 2, 3, 9 and 10 stand together and claim 2 is representative of this group. The remaining claims will stand or fall based on the patentability of claims 1 and 8. Arguments for the separate patentability for these two groups of claims will be presented in the Argument section of this Appeal Brief.

**ARGUMENT:**

I. Claims 1, 4, 5 and 6 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk U.S. Patent 5,340,437 (hereafter "Erk") in view of Datta et al. U.S. Patent 5,462,638 (hereafter "Datta").

The present invention as embodied in claim 1 is directed to the improved uniformity of etching of a film having a plurality of solder bumps. Appellants have found and asserted that this film etches slower at the kerf area of a semiconductor wafer where there are usually no C4 solder structures. (Appellants' specification page 3, lines 21-23 and page 4, line 1). Accordingly, in order to solve this problem first discovered by Appellants, Appellants have proposed rotating the

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

wafer to improve the uniformity of etching. The combination of references proposed by the Examiner do not suggest the problem found by Appellants nor its solution. "[A] patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is *part* of the 'subject matter as a whole' which should always be considered in determining the obviousness of an invention under 35 U.S.C. 103." In re Spinnable, 160 USPQ 237, 243 (CCPA 1969). The Examiner has not addressed this part of Appellants' invention in the Examiner's rejection of claim 1 and thus has failed to consider the "subject matter as a whole" of Appellants' invention.

Turning now to the references, Erk is directed to a process wherein a bare silicon wafer, which has been sawed and lapped, is immersed in an etchant bath and then rotated. The etching step is necessary to remove any work damage created by the sawing and lapping and to remove any embedded lapping grit. Among the objects of Erk are to uniformly etch the bare silicon wafer at slow rotation speeds and to have a relatively low total thickness variation across the wafer.

However, the Erk reference is distinguishable on at least three counts from Appellants' invention as embodied in claim 1. The first is that Erk is directed to the etching of bare silicon wafers to remove any residual effects of sawing and lapping. It is to be assumed that as a result of the etching process in Erk, such residual effects would be removed. There is nothing in Erk to indicate that the teachings of Erk would be applicable to any other process other than the removal

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

of such residual effects.

Second, Appellants' claim 1 is directed to a "method of improving the uniformity of etching of a film having a plurality of solder bumps" [emphasis added]. Improving the uniformity of etching is an important limitation of Appellants' claim 1. While Erk appears to address thickness variations, both locally and across the entire wafer (col. 2, lines 22-29), this is not the same as uniformly etching a film across the entire wafer as taught by Appellants. That is, Appellants want the same etching in the kerf area and the area with the solder bumps. Since Erk is etching a bare wafer, Erk cannot address this aspect of Appellants' invention.

Third, the teaching of Appellants' invention is that the presence of the solder bumps complicates the etching of the metal films (Appellants' specification page 3, lines 20-21). It cannot be assumed that the etching of a bare wafer as taught by Erk would be applicable to the etching of a wafer with a film having a plurality of solder bumps. Thus, there is no teaching in Erk to indicate that Erk would be applicable to improving the uniformity of etching of a film having a plurality of solder bumps as claimed by Appellants.

The deficiencies of Erk are not supplied by Datta. Datta is directed to the etching of one of the metallic films (i.e., TiW) underlying the solder bumps and merely teaches, as recognized by the Examiner, that for a semiconductor wafer having solder bumps, the metallic film may be

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

etched by "dip etching, which allows economical production with a simple throughput cassette-type etching process." (col. 7, lines 45-46). There is nothing in Datta to suggest the problem found by Appellants of nonuniform etching. Nor is there anything in Datta to suggest a method of etching by any other method than dip etching in a cassette-type etching process.

The Examiner states, however, that it would be obvious "...to modify Erk by immersing an article having a plurality of solder bumps as taught by Datta in a tank of etchant for the purpose of allowing economical production with simple throughput cassette-type etching process". It is not understood how the Examiner can jump from the Datta dip etching process where the wafers are in a cassette to a process, as claimed by Appellants, where the wafer is rotated to improve the uniformity of etching. Moreover, the Examiner seems to modify Erk by the cassette-type dip etching of Datta. Cassette-type dip etching is not what Appellants are claiming!

The Examiner concludes in the Final Office Action that "Since Erk in view of Datta use the same steps and film layer as those of the claimed invention, then combining Erk and Datta would inherently result in a method of improving the uniformity of etching of a film on an article as in the present invention." [emphasis added]. It is submitted that the Examiner's reasoning is flawed in that the foregoing reasoning is applicable to an anticipation rejection based on a single reference but is not applicable to an obviousness rejection based on multiple references. In re



**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

Rinehart, 189 USPQ 143 (CCPA 1976), In re Spormann, 150 USPQ 449 (CCPA 1966). It is noted that in the Advisory Action the Examiner has deleted the word "inherently". However, removal of "inherently" does not remove the Examiner's burden to provide a valid motivation for combining Erk and Datta.

Any motivation provided by the Examiner above for the combining of Erk and Datta is negated by the fact that Erk and Datta use different processes and wafers in their respective etching processes. "The fact that a prior art reference can be modified to show the patented invention does not make the modification obvious unless the prior art reference suggests the desirability of the modification. An attempted modification of a prior art reference that is unwarranted by the disclosure of that reference is improper." In re Gordon, 221 U.S.P.Q. 1125, 1127 (CAFC 1984).

If modified as suggested by the Examiner above, there would be a different process than that claimed by Appellants since Erk and Datta do not use the same steps and film layer. That is, Erk has no film layer and no solder bumps and immerses and rotates the wafer in an etching bath. Datta, conversely, does have a metallic film layer but etches the wafer in a cassette-type dip etching process. It should be readily apparent that Erk and Datta are directed to two different types of processes with two different kinds of wafers.

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

Given the flawed reasoning by the Examiner, it is submitted that the Examiner has yet to state a cogent motivation for combining Erk and Datta so as to render obvious Appellants' claim 1.

The Office has the burden under 35 USC §103 to establish a prima facie case of obviousness. In re Fine, 5 USPQ2d 1596 (CAFC 1997). "In determining whether a case of prima facie obviousness exists, it is necessary to ascertain whether the prior art teachings would appear to be sufficient to one of ordinary skill in the art to suggest making the claimed substitution or other modifications. [citations omitted] The prior art must provide one of ordinary skill in the art the motivation to make the proposed molecular modifications needed to arrive at the claimed compound." In re Lalu and Foulletier, 223 USPQ 1257, 1258 (CAFC 1984). "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." In re Fritch, 23 USPQ 2d 1780, 1783 (CAFC 1992).

In view of the preceding remarks, it is submitted that the Examiner has failed to state a prima facie case of obviousness with respect to claim 1. Accordingly, claim 1 should be allowable.

Inasmuch as claims 4 to 6 depend from claim 1, and claim 1 is believed to be allowable,

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

then claims 4 to 6 should be allowable as well. No independent ground of patentability is asserted for claims 4 to 6.

II. Claims 2 and 3 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta and further in view of Takeshi et al. (English Abstract of JP 9115977 A2) (hereafter "Takeshi"). Claim 7 has been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta and further in view of Barbee et al. U.S. Patent 5,445,705 (hereafter "Barbee").

Inasmuch as claims 2, 3 and 7 depend from claim 1, and claim 1 is believed to be allowable, then claims 2, 3 and 7 should be allowable as well. No independent ground of patentability is asserted for claim 7.

Claims 2 and 3 are believed to be independently patentable.

The Examiner states that Erk in view of Datta fail to teach the step of sequentially rotating the article as claimed in claims 2 and 3. The Examiner further applies Takeshi which reads on rotating the article a predetermined amount but less than a complete rotation and repeating the step of rotating and etching. The Examiner concludes that it would have been

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

obvious to modify Erk and Datta according to Takeshi "for the purpose of improving the method of detecting defects in semiconductor processing."

Erk and Datta have been discussed above. Takeshi discloses an analytical technique for detecting and analyzing so-called flow pattern defects (FPD) in semiconductor wafers. Takeshi is not directed at all to the problem faced by Appellants, to wit, improving the uniformity of a film having a plurality of solder bumps. The last statement above by the Examiner is telling. The Examiner has combined Erk, Datta and Takeshi "for the purpose of improving the method of detecting defects in semiconductor processing." That is, the Examiner has combined Erk, Datta and Takeshi to teach a solution to a problem not faced by Appellants. It is submitted that Takeshi is nonanalogous art. "In order to rely on a reference as a basis for rejection of the applicant's invention, the reference must either be in the field of the applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the inventor was concerned." In re Oetiker, 24 USPQ2d 1443, 1445 (Fed. Cir. 1992). "[T]he purposes of both the invention and the prior art are important in determining whether the reference is reasonably pertinent to the problem the invention attempts to solve. If a reference disclosure has the same purpose as the claimed invention, the reference relates to the same problem, and that fact supports use of that reference in an obviousness rejection. An inventor may well have been motivated to consider the reference when making his invention. If it is directed to a different purpose, the inventor would accordingly have had less motivation or occasion to consider it." In re Clay, 23 USPQ2d1058,

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

1061 (Fed. Cir. 1992). In the present case, the reference is directed to a different purpose, as admitted by the Examiner, and so should be considered to be nonanalogous art. Takeshi, then, should be withdrawn as a reference.

Accordingly, with respect to claims 2 and 3, the Examiner has failed to state a prima facie case of obviousness.

III. Claims 8, 11, 12 and 14 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Barbee (?).

While the Examiner has recited Barbee as the secondary reference, it is clear that the Examiner meant to recite Datta as the secondary reference in view of the Examiner's rationale for the rejection of claims 8, 11, 12 and 14.

Therefore, the reasoning recited by Appellants for the allowability of claim 1 is equally applicable here for the allowability of claim 8. That reasoning recited earlier is incorporated by reference herein. Accordingly, claim 8 should be allowable.

Inasmuch as claims 11, 12 and 14 depend from claim 8, and claim 8 is believed to be

**09/870,534****Patent****IBM Docket No. FIS920000349US1**

allowable, then claims 11, 12 and 14 should be allowable as well. No independent ground of patentability is asserted for claims 11, 12 and 14.

IV. Claims 9 and 10 have been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Takeshi et al. (English Abstract of JP 9115977 A2). Claim 15 has been rejected by the Examiner under 35 USC §103(a) as being unpatentable over Erk in view of Datta et al. and further in view of Barbee et al. U.S. Patent 5,445,705.

Inasmuch as claims 9, 10 and 15 depend from claim 8, and claim 8 is believed to be allowable, then claims 9, 10 and 15 should be allowable as well. No independent ground of patentability is asserted for claim 15.

Claims 9 and 10 are submitted to be independently patentable for substantially the same reasons advanced in favor of claims 2 and 3 and those reasons are incorporated by reference herein.

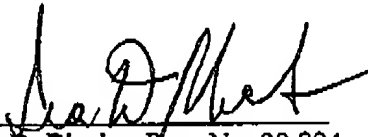
**09/870,534**

**Patent  
IBM Docket No. FIS920000349US1**

**SUMMARY:**

For all the reasons presented, it is submitted that the Examiner's various decisions in rejecting Appellants' claims were in error and reversal of the Examiner's decisions is respectfully requested.

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**09/870,534****Patent  
IBM Docket No. FIS920000349US1****APPENDIX**

1. A method of improving the uniformity of etching of a film having a plurality of solder bumps on an article, the method comprising the steps of:

immersing the article containing the film having a plurality of solder bumps into a tank of etchant;

rotating the article while in the etchant for an amount of time so as to cause improved uniformity of etching of the film across the entire article compared to etching without rotating the article;  
and

removing the article from the tank of etchant.

2. The method of claim 1 wherein the step of rotating comprises sequentially rotating the article.

3. The method of claim 1 wherein the step of sequentially rotating comprises rotating the article



**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

an amount but less than a complete rotation, etching the article an amount of time, and repeating the steps of rotating and etching for an amount of time.

4. The method of claim 1 wherein the step of rotating comprises continuously rotating the article an amount of time.
5. The method of claim 1 wherein in the step of rotating, the article is rotated at a speed of 1 to 5 revolutions per minute.
6. The method of claim 1 wherein the film is a metallic film.
7. The method of claim 1 wherein the film is a nonmetallic film.
8. A method of improving the uniformity of etching of a film having a plurality of solder bumps on a semiconductor wafer, the method comprising the steps of:

**09/870,534****Patent****IBM Docket No. FIS920000349US1**

immersing the semiconductor wafer containing the film having a plurality of solder bumps into a tank of etchant;

rotating the semiconductor wafer while in the etchant for an amount of time; and

removing the semiconductor wafer from the tank of etchant.

9. The method of claim 8 wherein the step of rotating comprises sequentially rotating the semiconductor wafer.

10. The method of claim 8 wherein the step of sequentially rotating comprises rotating the semiconductor wafer an amount but less than a complete rotation, etching the semiconductor wafer an amount of time, and repeating the steps of rotating and etching for an amount of time.

11. The method of claim 8 wherein the step of rotating comprises continuously rotating the semiconductor wafer an amount of time.

**09/870,534****Patent  
IBM Docket No. FIS920000349US1**

12. The method of claim 8 wherein in the step of rotating, the semiconductor wafer is rotated at a speed of 1 to 5 revolutions per minute.

14. The method of claim 8 wherein the film is a metallic film.

15. The method of claim 8 wherein the film is a nonmetallic film.

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